Planning for a changing climate: Using velocities and trajectories of sea temperature change to inform marine protected area planning

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Abstract

Marine protected areas (MPAs) are playing an increasingly important role in addressing conservation and fisheries management needs. Current best practices in planning and managing MPAs take into account both ecological and socio-economic considerations. However, there is an urgent need to incorporate the consequences of climate change into MPA thinking, as these will have significant impacts on both biodiversity conservation and fisheries management. To do so, we need to understand how climate change scenarios will impact existing MPAs and develop way to include climate change considerations in future planning processes. Using the UK as a case study, we show how climate change scenarios can be used to predict the velocity and trajectories of sea surface temperature change. Velocities of change are overlaid on existing MPAs to estimate how long each will 'contain' its existing isotherm. On the assumption that migrating isotherms may result in changing community composition within the MPAs, an assessment on the long-term viability of existing MPAs is made. The most vulnerable habitats are identified by overlaying predicted change with habitat maps. We also use the isotherm trajectories to identify original locations of isotherms migrating through MPAs, which can inform mitigation planning. We also demonstrate how velocity of change can be incorporated in to Marxan analysis as a surrogate cost layer, and by doing so, how climate change considerations can be quantitatively incorporated into strategic conservation planning and the designation new protected areas.